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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAY 9 1980

Generic Task No. A-7

DOCKET NOS.: 50-219, 50-220, 50-237, 50-245, 50-249, 50-254, 50-259, 50-260, 50-263, 50-265, 50-271, 50-277, 50-278, 50-293, 50-296, 50-298, 50-321, 50-324, 50-325, 50-331, 50-333, 50-341, 50-354, 50-355, and 50-366.

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SUBJECT: SUMMARY OF MEETINGS HELD ON APRIL 22 AND 23, 1980 WITH REPRESENTATIVES OF THE MARK I OWNERS GROUP

On April 22 and 23, 1980, the staff met with representatives of the Mark I Owners Group in San Jose, California to discuss confirmatory analysis and testing programs relating to the Mark I Containment Long Term Program. The specific agenda items (i.e., downcomer "condensation oscillation" loads, pool swell compressibility effects analyses, and the supplementary full-scale condensation test series) are those ongoing issues for which resolution is necessary to complete the generic aspects of the program. The purpose of this meeting was to identify the information that would be needed to conclude on these issues. The meeting attendees are listed in Enclosures 1 and 2.

Tuesday, April 22

R. Palaniswamy, Bechtel, presented the proposed downcomer load specification for the "condensation oscillation" regime. A refined analytical model of the Full Scale Test Facility (FSTF) vent system has been calibrated with static ("jack" test) and dynamic ("snap" test) downcomer - vent header response data. The analytical model and response data comparisons are described in Enclosure 3.

The load specification was derived by assuming an oscillatory (i.e., sinusoidal) pressure load within the vent system and comparing the calculated structural response to the response data from FSTF. From the analyses, a design load has been derived equivalent to a 1.5 psi static differential pressure, ± 2.5 psi at 5.5 Hz* oscillatory vent header pressure, and ± 5.0 psi at 5.5 Hz* oscillatory downcomer pressure. The load would be applied in-phase with a damping value of 6% (lowest damping observed in the applicable "snap" tests). Comparisons of the calculated response to the proposed design load with the FSTF response data indicates that the proposed design load is between 35% and 95% conservative. A report to document the bases for this load specification will be completed about May 1980.

The staff considered the approach presented to be viable. However, the analyses suggest that the downcomer response mode is near resonance, evidenced by significant amplification. Thus the vent system analytical model may be responding to a mode of response other than the "wishbone" mode. Therefore, the staff indicated that the assumed 6% damping must be justified (e.g., compare displacement in the pool) and the range specified for the driving frequency must consider the proximity of the response mode frequency. These considerations will be addressed in the forthcoming report and the load specification will be confirmed by data from the supplement FSTF tests.

R. Torak, Accurex, described the analyses which were used to investigate the effects of compressibility on scaled pool swell loads (report NEDE-24778-P). The analyses consisted of a finite element, compressible, one-dimensional vent flow model coupled to a semi-empirical bubble/pool-swell model. The bubble model was calibrated with Quarter Scale Test Facility (QSTF) data. The coupled analytical model was then applied to ideal QSTF test conditions and equivalent full-scale conditions. The results of these analyses indicate that compressibility tends to mitigate the pool swell loads by a net reduction in the mass and energy into the bubble. For water leg lengths less than about four inches, the download or the torus tends to be higher at full-scale conditions; however, the Mark I Owners indicated that all plants intended to operate with water legs greater than six inches.

Following the discussion of the compressibility analyses and conclusions, the Mark I Owners representatives addressed the comments submitted by our consultants at BNL in a letter dated March 12, 1980 (J. D. Ranlet,

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*GE will specify a frequency range to assure conservative plant-specific loads.

BNL, to C. Grimes, NRC). The principal comment concerned the relative accuracy of the analyses with respect to the number of nodes and time-step size. R. Torak presented the results of error studies (Enclosure 4) which indicate that the total error in load magnitude is less than about 5%, compared to a mitigation effect of approximately 20% for the net upload. The net downloads were affected less by error. The principal reason for the relatively low error was the prototypically low Mach numbers for the vent flow rate (approximately 0.3). Additional information concerning node and time-step sensitivity and model descriptions were presented in response to questions raised in the BNL report.

The staff and consultants concluded that two additional analyses (i.e., full-scale and equivalent 1/4-scale) should be performed which would model the drywell with a constant mass inflow and use the same scaled vent system models. The comparison of the integrated mass flow up to the time of peak upload for these two analyses would be sufficient to demonstrate the "mass defect" between the scaled QSTF and full-scale equivalent vent flow. The Mark I Owners Group agreed to provide such analyses in a letter report. The staff concluded that this comparison would provide a sufficient basis to demonstrate whether compressibility would constitute a mitigating effect for the Mark I vent flow conditions.

The Mark I Owners Group inquired about the additional efforts that would be needed to take quantitative credit for the mitigating effects of compressibility on the torus pool swell loads. The staff responded that considerable justification would have to be presented for the assumptions and judgements inherent to the vent flow model and extrapolation of the empirical bubble formation parameters. The staff indicated that quantitative credit would be unlikely, because the analyses would have to be good enough to quantify pool swell loads, in which case a three-dimensional flow model may be necessary.

<u>Wednesday, April 23</u>

C. Collins, GE, described the FSTF supplemental tests that are to be performed in May and June 1980 (Enclosure 5). These tests will duplicate test M8 (design-basis liquid break) and will be designated M11 and M12. The only difference in the facility from the M8 configuration will be that all of the downcomer pairs will be "tied" and additional instrumentation has been installed on the downcomer-vent header system. The Mark I Owners Group indicated that examination of the vent system welds was performed before the "snap" tests and no evidence of damage due to the previous test series was found.

The Mark I Owners Group suggested a meeting with the staff in July 1980 to review the "quick-look" data from tests M11 and M12 and data comparisons to test M8 The "quick-look" data would include (1) test initial conditions, (2) bottom-center wall pressure transients, (3) pressure transients from the extreme downcomer pairs, and (4) downcomer - vent header and downcomer - tie strain measurements. The staff requested that, in order to provide an expeditious resolution to that issue, the Mark I Owners should plan to submit an interim report following the July 1980 meeting which would provide sufficient information for the BNL consultants to develop a supplement to the Mark I SER. Specifically, this report should include comparisons of the pressure - frequency spectra from tests M8, M11, and M12 and the Load Definition Report (LDR) to establish the conservatism in the torus shell pressure load specification, and a phasing evaluation of the pressure transients in the two extreme downcomer pairs. A complete report of the test results could then be issued in December 1980, as planned, without affecting the overall schedule for the resolution of the Mark I program.

W. Kennedy, Structural Mechanics Associates, described the results of analyses which were performed to investigate the effects of the relative phasing of the harmonic components of the "condensation oscillation" torus shell pressure - frequency spectra (Enclosure 6). The results of this analysis indicated that neither the assumed pressure amplitude, 2% damping, nor steady-state loading contributed much to the conservatism in the design load. Cumulative Distribution Functions (CDFs) were developed for the Bechtel model of FSTF (i.e., Monticello) and the NUTECH model of Oyster Creek. From an assessment of these CDFs, the following design rule was developed:

1. Use LDR pressure - amplitude spectra and 2% damping.

2. Absolute sum the responses of the three (3) highest amplitude harmonics.

3. Square-root-the-sum-of-the-squares (SRSS) the responses of the remaining 27 harmonics (up to 30 Hz).

This design rule results in calculated structural responses which essentially match the peak responses observed in FSTF test M8.

The staff noted that the load specification proposed in the LDR was considered acceptable because the conservatisms provided by the coupled load - structure analysis techniques (i.e., absolute sum of all of the hormonics) would offset the uncertainties associated with the stochastic nature of the phenomena (i.e., uncertainty in the load magnitude). Therefore, further consideration of the proposed design rule must be deferred until the load magnitude uncertainty can be quantified from the supplemental FSTF tests.

Once adequate documentation of these tasks has been submitted to the NRC, as described above, and providing there are favorable results from the supplementary FSTF test series, the staff will conclude the generic aspects of the Mark I Containment Long Term Program with a supplement to the Safety Evaluation Report.

C. I. Grimes

C. I. Grimes
A-7 Task Manager
Generic Issues Branch
Division of Safety Technology

Enclosure: As stated

See subject files

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